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Different Methods for Detection of Nanoparticles for Semiconductors and Photovoltaic Cells through Diffraction & Novel Approaches

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Abstract

Different physical and chemical techniques used for discovery of innovative nanoparticles with emerging applications in the fields of x-ray diffraction that can use as most important technique for optical measurements of nanosacle objects. Silver and gold nanoparticles formulations can be easily accessed through the different methods such as lithographic and vacuum deposition of metal, but appeared to be expensive techniques. Semiconductor based nanoparticles possess the magnetic properties with excellent electrical conductivity due to which they are used in different appliances and engineering works. Semiconductors have introducing impurities into their crystal lattices through traditional techniques or methods that designed at industrial and commercial level. The photovoltaic cells that synthesized through nanotechnology approach possess the photofunctional materials; nanoscale architectures usually exhibit unique optical and electronic properties. One of such kind of example is the alternative technologies to silicon based chip with combinations of various parts through nanotechnology.

Keywords: Nanotechnology, semiconductors, photovoltaic cells, mechanical properties.

INTRODUCTION

There are different techniques used for detection of nanoparticles on the basis of size and other characteristics features. Advances in physical and chemical techniques leads to discovery of innovative nanoparticles with emerging applications in the fields of x-ray diffraction, electronics, electrical conductivity and measurements of heat capacities of different objects [1, 2]. One of such kind technique is the powder X-ray diffraction that is used for studying the crystals based chemical properties of nanoparticles. X-ray diffraction is used for actual structure deviates from the ideal one, owing to internal stresses and defects during the synthesis of nana based materials. Anisotropic peak broadening related to crystallite shape, defects, and microstrain occurs frequently in nanomaterials and can significantly complicate the analysis. Therefore, more accurate analysis of different nanoparticles can be performed in order to measure their characteristics that distinguish them from other materials due to compact surface, mechanical based properties and high conductivity [3-5].

X-ray diffraction is also used for measuring the different properties of nanoparticles also used for characterization of nanosacle materials. It measures the size of nanoparticles through detection of crystal based properties of nanoparticles under experimental investigation [6]. It also provides the important information that is complementary to various microscopic and spectroscopic methods, such as phase identification, sample purity, crystallite size, and, in some cases, morphology. X-ray diffraction has become the value technique that critically used for measuring the phase properties of different particles under different conditions [7, 8]. This technology can be employed for discovery of nanoparticles that could be used for studying the crystallographic measurements.

These possess different information values, reliabilities of results obtained, and calculation laboriousness. Selecting one of these methods important for the analysis of different objects. Accuracy of delivery of nanoparticles through X-ray diffraction more precise able than those traditional techniques that are costly [9, 10].

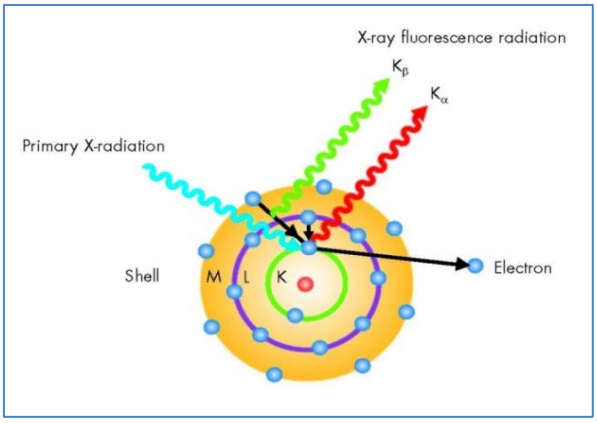

Fig-1: Shows the principle of x-ray radiation via shells system

There are several approaches X-ray diffraction for analysis of nanoscale materials with mechanical properties. For determination of structure of different nanoparticles or nanoscale materials, width and shape of reflection yield information about the substructure of the materials sizes of crystallites, microstrain of a lattice, dislocation structures [11]. These features of X-ray diffraction leads to synthesize the different nanoparticles with applications in heat transfer, mechanical based thermoregulators, electronic devices used for physical operations. X-ray diffraction as most important technique for optical measurements of nanosacle object [12].

Silver and gold nanoparticles formulations can be easily accessed through the different methods such as lithographic and vacuum deposition of metal, but expensive techniques. The high cost in these methods leads too much consumption of energy also required for preparation of nanoparticles and characterization [13, 14]. One of the suitable, simplest and low-cost methods is co-precipitation method which can be used in wide range of materials. The complex formed by silver nanoparticles can be immobilized through physical methods in order to enhance the catalytic performance of newly synthetized nanoparticles [15, 16].

There are many factors influenced on formulations and characterization of novel nanoparticles. The common factor in nanotechnology is the lateral dimension of the accurate measurement of atomic and molecular distances within structures ranging from semiconductor devices to nano-powders [17, 18]. There are many other techniques advances in their instrumental manufacturing leads to accurate determination of thickness, roughness, and density of nanoparticles. X-ray reflectometry determines layer thickness, roughness, and density while on the other hand; high-resolution diffraction can measure the lattices properties and dimensions of nanoparticles [19].

Scattering of light as important for synthesis of nanoparticles in order to employ the optical properties. Modifications in different nanoparticles leads to synthesize the industrial based compounds with scattering properties [20]. A regular array of scatterers produces a regular array of spherical waves. In the majority of directions, these waves cancel each other out through destructive interference. The most promising nanoparticles in the nanotechnology are the sliver nanoparticles with size range between 1-100 nm. These nanoparticles are extensively studied in physical studies in order to elucidate the size and shape depending optical, electrical, and magnetic properties. They are ideally important in industrial manufacturing of composite fibers, cryogenic superconducting materials, cosmetic products, and electronic components [22, 23].

Role in Designing of Semiconductors

Different types of nanoparticles can synthesized through the nanotechnology by incorporation of semiconductor materials during processing. Semiconductor based nanoparticles possess the magnetic properties with excellent electrical conductivity due to which they are used in different appliances and engineering works [24]. Zinc oxide is a distinctive electronic and photonic n-type semiconductor with a wide direct band gap of 3.37 eV and can be easily synthesized at room temperature but under different concentrations of nanomaterial employed used in their synthesis. Nanoparticles can be employed in semiconductors technology through the combinations of semiconductor quantum dots. This approach leads to higher light absorption in particular in the infrared spectral region of the photo current at higher temperatures [25, 26].

Nanotechnology playing important role in designing of variety of semiconductor such as transistors, switches depending upon the nature of particular materials composed of nanoparticles [27]. Nanocrystals based semiconductors formulations can be used for different industrial processes. Different types of semiconductor with combinations of nanocrystals are commonly used as probes for labeling owing to their intense, tunable fluorescence [28]. Semiconductors with recent advances in the field of physical sciences lead to synthesize emerging materials with high quality, thermal resistance and optical properties. Semiconductor nanomaterials have interesting physical and chemical properties and useful functionalities, when compared with their conventional bulk counterparts and molecular materials [29].

Advances in semiconductor technology have been made in order to increase the demand of nanomaterials that employed used for their synthesis [30]. Semiconductor based NPs are composed of semiconductor materials at nanoscale high surface area, and quantum size effects. They are used LEDs, different types of diodes, solar cells synthesized based on nancapsules and quantum computing [30]. These properties make the significant value in semiconductor marketplace by replacing the traditionally used semiconductors. Some of the semiconductors that high cost due to large time required in their preparation are not reliable. Therefore, semiconductors based on nanoparticle as dominate in electronics [32].

Semiconductors have introducing impurities into their crystal lattice through traditional techniques or methods that designed at industrial and commercial level. Semiconductors that can be designed to improve the electrical conductivity and mechanical properties in order to improve their quality. These are working under different conditions such as light source. When light falls on them, they can generate current and voltage, the photons produce electron-hole pairs, and the dipole electric field provides for a separation of these charges [33, 34].

Role in Designing of Photovoltaic Cells

Photovoltaic cells can be synthesized through nanotechnology by employing high quality materials due to thermal and mechanical properties. The photovoltaic cells that synthesized through nanotechnology approach possess the photofunctional materials; nanoscale architectures usually exhibit unique optical and electronic properties [35]. These materials become the more popular and their demand increasing due to their efficient production, low cost and high compact materials used to design to structural formation. It based on demand of clean electricity production based on renewable energy sources. Photovoltaic technology also employed the crystalline nature silicon to address the troubleshooting in proper supply of electricity. The largest share of the actual PV electricity supply is still based on crystalline silicon wafer solar cells. There is need to design such kind of cells that supply electricity with low cost and maximum production both industrial and commercial level [36].

Electronic and photonic information technology and renewable energy alternatives, such as solar energy, fuel cells and batteries, have now reached an advanced stage in their development. Many of the electronic based devices are synthesized through the applications of nanotechnology due to feature sizes of the latest generations of electronic devices are approaching atomic dimensions, circuit speeds are now being limited by interconnect bottlenecks[37]. This approach leads to discovery of new materials that can be incorporate to microelectronics prior to use for different purposes. One of such kind of example is the alternative technologies to silicon based chip with combinations of various parts through nanotechnology. This silicon-nanotechnology approach helpful to design the novel materials by replacing the traditional materials used for industrial purposes [38].

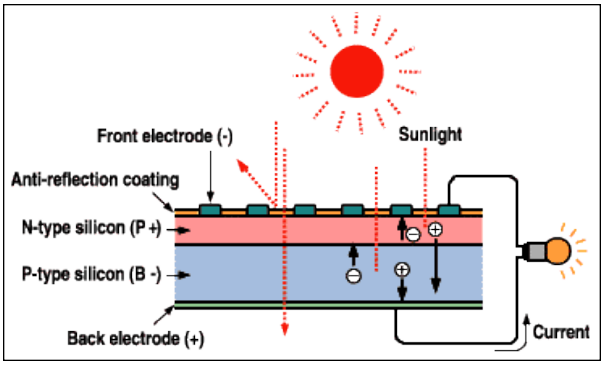

Fig-2: Shows the principle role of nanotechnology in photovoltaic cells

Nanotechnology is more reliable for designing of high quality photovoltaic cells that comprised of fine layers of very small crystals [39]. These crystals possess the different physical and mechanical properties to maintain the environmental stresses. Silicon based crystals required extensive materials in their preparation for folding and shaping into final processing stage. Due to high cost, these crystals have replaced by nano based silicon crystals. Sensitizing dyes are being used to increase the range and location of the wavelengths that can be absorbed to be more favorable to sunlight, allowing the use of materials that lack this key characteristic. Silicon crystals are made up of fine layers of film in order to process through the semiconductor technology [36, 40].

CONCLUSION

Electrical energy can be created through the solar cells with recent advances in nanotechnology to solve the problems electrical energy. The existence of a storage unit, such as a pump, is also required in order to adjust the power supply at the moment. This makes the save energy consumption as nanomaterial more reliable than traditional energy production tools that are too costly and environmental hazarders. Therefore, the nanobased solar cells are being used to replace the other cells used for energy production.

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